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Landscape Restoration at Death Valley, California, USA: Macro-Imagineering Industrial "Pleistocene" Landscape

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Abstract: This suggested evaluation is a forecasted future [1] industrial option for transporting rejected desalination factory brine to Death Valley, State of California, USA. The purpose of this proposal, which would form an anthropogenically enlarged Salton Sea, is to provide long-term storage of precipitated brine salts that in turn would foster a flat solar-reflective landscape. This macro-imagineering proposal has additional beneficiation when combined with additional industrial utilization and downwind climate regime mitigation. The goal or purpose of this macro project is established, new desalination technologies that produce 1 m^3 of brine for every 10 m^3 of freshwater derived from developing photovoltaic and/or geothermal technologies. A previously well-postulated floating desalination scheme for the spatially enlarged Salton Sea, could produce a maximum of ~44 km^3/year of rejected brine that can, in turn, be emplaced in California's unsettled hinterland [2]. This salty wastewater disposal proposal is offered as an economically feasible 21st Century co-dependent hydraulic-electricity grid Macro-Imagineering project.

Key words: State of California, Death Valley, Desalination, Macro-projects, Brine disposal, Electricity grid, Aralkum.

Resumo: A sugestão apresentada, prevista para o futuro [1], é uma opção industrial de transporte de salmoura rejeitada, proveniente de usina de dessalinização, para o Vale da Morte, Estado da Califórnia, EUA. O objetivo desta proposta, a qual formaria um Mar de Salton antropogenicamente ampliado, é fornecer armazenamento de longo prazo de sais de salmoura precipitados que, por sua vez, promoveriam uma paisagem plana refletiva ao sol. Trata-se de uma proposta de macroimaginação com benefícios adicionais quando combinada a processos industrias e mitigação do regime climático a favor do vento. Este macroprojeto propõe o emprego de novas técnicas de dessalinização — que produzem 1 m^3 de salmoura para cada 10 m^3 de água doce — associadas à aplicação de tecnologias fotovoltaicas e/ou geotérmicas. Um esquema de dessalinização flutuante previamente bem ajustado para o Mar de Salton ampliado poderia produzir um máximo de ~44 km^3/ano de salmoura rejeitada que seria, por sua vez, colocada no interior instável da Califórnia [2], constituindo assim um sistema de disposição de águas residuais salgadas economicamente viável no Século XXI.

Palavras-chave: Estado da Califórnia, Vale da Morte, Dessalinização, Macroprojetos, Eliminação de salmoura, Rede elétrica, Aralkum.

1 Introduction

The traditional system for rainwater harvesting, a matter of wonder, designed to make water available in the dry season in the Deccan Plateau, where rainfall is seasonal, and often ill-distributed, is briefly described. It is shown how the lay of the land and naturally formed drainage were utilized to build storage structures (artificial lakes) using simple but clever engineering. The downstream flow was used to interconnect these storage structures and, most importantly, to utilize the water, thus made perennially available, remained under local control.

In tandem with Earth's gravity, the climatic seasons, traditional life-styles, and topographical nostalgia are expressed as everyday human life-maintenance, the processes continuing with inherent public-perceived simplicity [3]. Team Geographos members have intentionally sought to extend their imaginations and pretend behaviors, which characterized childhoods, because these efforts provide useful Macro-Imagineering concepts that offer new options for landscape management possibilities! According to 2 Corinthians 4:18: "We look not at what can be seen but at what cannot be seen". Possibly every infrastructure in the State of California was established in prospect, installed to meet public demands of an imagined future. Deathly sick people usually have no long-term survival goals; yet those living usually continue striving to exist, sometimes by willpower alone [4]. Oddly, many scientists advocate Resurrection Biology— "de-extinction"—that would return by artificial selection, species sorting done solely by human deliberation, of plants and animals no longer roaming southern California's now-arid landscapes but which occupied that landscape when wetter climatic regimes prevailed during the Pleistocene [5]. We apprehend such an action as equivalent to opening Pandora's Box. Decades ago, biologists first proposed re-wilding of the 362,600 km2 Great Basin Watershed, one of the USA's driest regions, by complex restoration using some preferred Pleistocene flora and fauna [6]. The Great Basin was designated "Greater California" in *Metropolitan Frontier* (1995) by historian Carl Abbott [7].

Reference to previous articles in CALIBRE suggest intriguing potential mega-projects that could favorably shift on-going degradation, desiccation, and diminishment of the Salton Sea to a better future economic and environmental trajectory after volumetric enlargement [8-9]. The Imperial Valley, where the fast-evaporating Salton Sea is located, cannot become California's largest dust-emitting toxic dump site like the southern Central Valley's grotesque Kesterson Wildlife Refuge sacrifice region [10]. Although deserts seem advantageous as landfill sites because of the near absence of precipitation and high rates of evapotranspiration coupled with natural, climatically-stressed biota and low-density human populations, southern California's arid landscapes need to be utilized for better human industrial purposes accompanied by enhanced landscape aesthetics. An antonym for junk-littered space is salvage space. California's elite political class, along with so-called "Greens", have benefited (financially and otherwise) from the media-induced public trance that is fixated on the supposedly "demonstrated ineffectualness of many demonstrated technologies" suggested by Macro-Imagineering's optimists as doable. That

is, the all-talk half-measures by State and local officials to mitigate the Imperial Valley's adverse environmental qualities enrich only far-distant legislators and some selected private-sector advisory groups, some of whom receive taxpayer-provided funds for their reportable contributions. In response, Team Geographos asks: What might be the geo-environmental result if an enormous volume of locally unwanted brine (derived from seawater desalination factories afloat on an enlarged Salton Sea) were deposited in Death Valley via an alternative long-distance wastewater conveyance?

2 Ancient and modern lakes

In the New World, two places with the lowest elevation are Laguna de Carbon, Argentina (minus 105 m, 49^{o} 35' S by 68^{o} 20' W) and the eponymous "Badwater" salt-flat in Death Valley (minus 85.5 m at 36^{o} 51' N by 117^{o} 17' W). Figure 1. The 883 km^{2} part of Death Valley that is currently below sea-level could hold ~44 km^{3} of precipitated brine salt [11].

Figure 1. The Badwater Basin occupies the lowest point in California. Other sites that are below sea level include parts of the Imperial Valley (exemplified by the Salton Sea) as well as the Sacramento River-San Joaquin River combined delta which empties its flow-through polluted freshwater into San Francisco Bay.

Death Valley has not supported a perennial freshwater lake since the total desiccation of Lake Manly circa 10 ka; currently it is an ugly dry-land because it sits in the rain-shadow of four major nearby mountain ranges. Fed by eastward runoff from Owens Lake (elevation ~1,100 m) [12], China Lake-Lake Panamint (~690 m) overflows, and the north-flowing Mojave River during the Last Glacial Maximum [13], Lake Manly (lake floor about minus 86 m) attained an area of ~1,600 km^2 and a maximum water depth of ~70-80 m. With the existing unaltered topography, a 12,000 km^2 anthropogenic Death Valley Lake ("A" in Figure 2) consisting of imported brine could be dammed to prevent overflow of the bedrock saddle at Ludlow (34^o 43' N by 116^o 09' W) and, theoretically, could be stopped from discharging southward into the Bristol-Cadiz-Danby Lake basins and, ultimately the Colorado River which empties into the Gulf of California [14]. Figure 2 shows that Death Valley serves as Nature's ultimate terminus for the Death Valley regional surface-water and groundwater flow system.

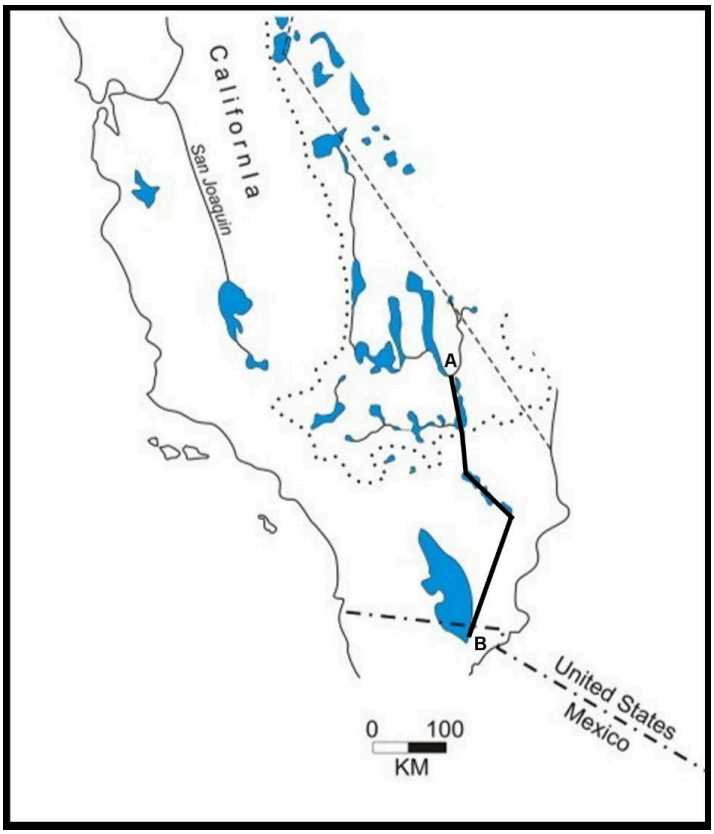

Figure 2. This map illustrates the now-vanished Pleistocene lakes and rivers that once dominated Southern California's landscape. In a previous issue of CALIBRE**,** Team Geographos advocated the artificial enlargement of the present-day Salton Sea (B) to its former Pleistocene area. In this report, a brine disposal pipeline was proposed to shift brine from B to A, the location of the former Lake Manly that is nowadays known as Death Valley. The dotted line marks the watershed boundary of the Great Basin.

California's Mojave Desert territory, lying east of the City of Los Angeles, is devoted to utilitarian intrusion land uses such as military training bases, grazing, freshwater aqueducts (since 1913 the Los Angeles Aqueduct and since 1939 the Colorado River Aqueduct), electric transmission line rights-of-way, mining [15] and irrigated agriculture. Mojave Desert landscape corridors for transmission lines may soon become more intensively utilized because the State of California's present government desires imported electric power rather than constructing new in-State generation capacity. This region covers ~7.4 million hectares in Southern California. Interestingly, California's three largest (by area) cities include Los Angeles, San Diego, California City in the Mojave Desert! The 528 km^2 California City (35° 07' N by 117° 59' W, ~15,000 citizens) in Kern County was established in 2004 as its Mojave Air and Space Port. State laws focused on prevention of urban sprawl could harm in future efforts to place additional such facilities (which center on drones, spacecraft, aerospace planes and satellites) in low-cost/low maintenance industrial landscapes such as the remaining Mojave Desert. The evaporating and polluted Salton Sea, like its Old-World counterpart the Aralkum [16], has become the USA's largest monitored primary biota succession experiment. Approximately 83% of the industrially contaminated former bed of the Aral Sea [17] is now exposed to dispersal by wind. Each new desert, in the Old and New World, constitutes a new source of toxic blowing dust. Dry salt basins of California, Nevada, and western Utah, for example, are largely relict inland saline lakes. Because these salt-encrusted basins are supplied by endorheic drainage, they entrap and concentrate mobile mineral elements [18]. Through leaching and seepage, these basins have become hydrologic sinks where toxic elements are concentrated in confined regions and which also migrate underground. Team Geographos has already proposed methods to repair, improve, camouflage, and transform both young analogue deserts.

Still, by means of a comprehensive "anthropohydrocosm" [19], voluminous young bodies of water (including fresh as well as salty fluids) have been formed on the world's landmass. It is possible that ~104 km^3 of saltwater is currently pooled in extant natural and anthropogenic saline lakes visible on the Earth's surface [20]. Okinawa's Yanbaru Seawater Pumped Storage Power System (functional 1999-2016) was the world's first pumped-storage electricity power-plant to operate using only seawater. Several major technical issues had to be addressed, such as sealing the reservoir, preventing penstock leakage, and means to effectively prevent the spread of seawater by the wind, all of which can cause serious and undesirable environmental impacts. From 2015, a Chilean company, Valhalla (http://valhalla.cl/en), planned to construct its Espejo de Tarapaca Project solar-powered seawater pumping system near the northern Chile shoreline of the Atacama Desert about 100 km south of the City of Iquique; very optimistically, Valhalla officials predicted the company could eventually supply transmitted electricity to supply the needs of all South America by circa 2040-2045 AD! Until the 1960s, the State of California deployed innovative macro-engineering solutions that collected and conveyed massive freshwater supplies obtained from the Sierra Nevada Mountain Range to the San Joaquin Valley and Southern California [21]. Team Geographos devised a scheme [8] that would supplement those now-inadequate freshwater transportation linkages, expanding California's hydraulic-electricity grid in order for Southern California,

especially its inland region, to cope with expected future State-wide droughts [22]. Whether Gulf of California seawater (1,030 kg/m^3) is imported to the Imperial Valley via pipeline [23] or canal, the result after desalination will be brine (1,230 kg/m^3) and precipitated salt accumulation in the basin of a stabilized or enlarged Salton Sea because the Salton Sea is an artificial lake affected by a dryland climate regime [24]. Sometimes the Colorado River flows with water infused with radioactive uranium mine tailings! Unless stopped, dumping of rejected industrial brine into the Gulf of California would add to the international high-salinity brine disposal dispute instigated in years past, the complicated hydrological-political USA-Mexico macro-problems caused by long-term over-extractions of natural freshwater from the Colorado River [25]. Hence, Team Geographos' solution: its concept of the Death Valley Lake as a brine disposal site with additional geophysical advantages.

3 Death Valley: a present-day landscape of desertic dearth

Wastelands are defined by the absence of perpetual geophysical qualities, barren landscapes that seemingly resist human ideals of proper or appropriate use and, as well, human common assessment as "environmentally insensitive" [26-27]. The existing uninhabited Death Valley [28] fits that simple descriptive definition; our Death Valley Lake will not! [8] postulates that replacement of freshwater abstracted from the Lower Basin of the Colorado River with massive desalinated water can allow the Upper Basin's riparian to build more reservoirs; in other words, desalinated seawater manufactured from a super-sized floating silicon photovoltaic plant sitting atop an enlarged Salton Sea [29] then becomes a predictable piped output quite unlike the naturally variable Colorado River runoff. And, desalination permits Californians, Nevadans, and Arizonans to become "independent of Nature" by means of highly technical new freshwater supply and tubular conveyance infrastructures. Freshwater use varies in amounts throughout the whole day, whilst present-day commercialized solar irradiation occurs only during daytime; yet, with desalination seawater supply moving inland from the North Pacific Ocean there can never be a "shortage" of the basic needed fluid element! At the moment, Team Geographos asserts its preference that geothermally-powered helical rotor brine pumps be employed to shift rejected brine from the Salton Sea Region to Death Valley. (In Mexico, freshwater is piped >150 km and lifted up a >1,200 m topographic gradient to reach customers in Mexico City; in the USA, the A.D. Edmonston Pumping Plant lifts freshwater from the southern San Joaquin Valley over the Tehachapi Mountains into the Los Angeles Basin, a height of ~610 m.) Geothermal power requires deep-drilling and careful operation since there are many geological unknowns affecting the stability of the Imperial Valley-Death Valley corridor of Earth's crust [30]. Therefore, it will be a requirement that Team Geographos explore the region thoroughly, perhaps using a small fleet of 2020 Jeep Gladiator Mojave vehicles.

A future, intensely transformed, Death Valley — that is, our realized plan for a Death Valley Lake — hinges on the usefulness, other than brine salt deposition, of such a gigantic anthropogenic water body. Firstly, it is known

for sure that radioactive groundwater, migrating from the continental nuclear weapons test area, the Nevada National Security Site, has been discovered at a surface spring near Death Valley [31]. Emplacing a thick stratum of salts, naturally precipitated from imported brine, should obviate closure of Death Valley due to impending contamination with radioactive elements. Contamination is, of course, a major Public Health risk. Secondly, if Californians emplace a huge controlled white-colored salt crust then the increased albedo of Death Valley should cool slightly the famously hot summertime air temperatures [32]. In modern times, Death Valley received unexpected freshwater river runoff from unusual passing storms during 18 October 2015 and 7 March 2019. Subaerial salt-flats are equivalent to ice-sheets and glaciers in their reflection of sunshine. In addition to the Mojave Air and Space Port, it is conceivable that a Death Valley Lake Aero-space Port might prove to be a feasible aero-space craft landing and take-off infrastructure — comparable, but spatially larger, than Israel's commercial Dead Sea Airport. Aero-space planes, such as the UK's SKYLON, could operate on reliable schedules because the weather conditions thereabouts will not likely be detrimental to such operations! Such aerial traffic will reduce the local investment bias, benefiting companies, diversifying, and broadening extra-regional investments. Thirdly, water evaporating from the brine, leaving a layer of whitish salts ultimately, will produce water vapor that will be entrained in generally eastward-moving air-masses, thus exporting water vapor to the Great Basin, a dry region which could possibly then receive more rainfall and snowfall [33]. However, we do not expect a Nature-made reappearance of the Pleistocene's Great Basin and California lakes!

4 Final remarks

Macro-imagineering constitutes the conceptual and philosophical foundation (in the sense given by Bunge to the philosophy of technology [34]) of the great engineering solutions for the great environmental problems that humanity creates in its billions of life-form passages through the world. In a way, we can see ourselves as the species that destroys in order to rebuild. This has been the great paradox of our existence. However, the destructive side still tends to override the reconstructive capacity, as there are so many types of damage that we do not know if we shall have time and resources to regulate the anthropic balance effort. The drying up of the planet and the concomitant increasing scarcity of freshwater make up a frightening and potentially very close scenario. The reversal of such a panorama offers a wide problematization for geoengineering, or large-scale environmental engineering, or even, as we like to say, terraforming-engineering for the Earth itself.

If we add together all the water bodies that have disappeared or lost their original mass in the last hundred years in a list headed by the pathetic Aral Sea, including ancient rivers in the north of southeastern Brazil, in addition to the bays, lakes and lagoons silted up by the rectification of water courses for agriculture, and the depletion of freshwater reserves by the model of confinement of animal herds, there seems to be no doubt that desertification is a very real possibility.

The dryness of our home world is directly proportional to human ignorance when relating to the environment. So, we think that Macro-Imagineering is also a result of environmental education as an urgent tool in all nations to repress the strange and contradictory human nature (as it is said in Brazil, "we bite and blow the wound"). But environmental education also involves changing eating habits. Do we really need to consume so much beef and so much dairy? Judging by the amount of food that ends up in trash, it seems not! Food waste is more than a paradox; it is absurd, as absurd is the irrational management of water.

A terrifying man-made desert called Aralkum — the lethal sea bed of the old Aral — was left as a bitter reminder of what we are capable of. Therefore, we need to show our children that we also know how to geoengineer paradises. Otherwise, as much as we are Macro-imagineers, only thistles and thorns will remain.

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